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## EUROPEAN PATENT APPLICATION

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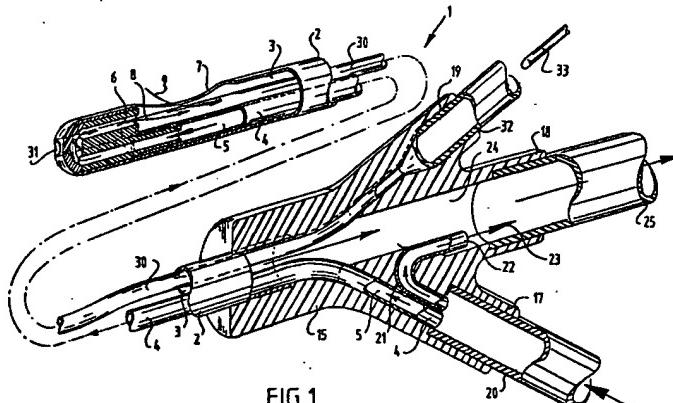
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## (54) Suction catheter

(57) The invention relates to a suction catheter comprising a tube-like basic body with a distal end and a proximal end, and a pressure channel and a discharge channel formed therein. At the distal end the pressure channel is connected with a spray nozzle and the discharge channel with a suction inlet and at the proximal end the chan-

nels are connected to connecting members, wherein the basic body in cross-section has a substantially constant cross-section with a lumen forming the discharge channel and the pressure channel has been formed in a separate tube-like body which has been received inside that lumen.



**Description**

The invention relates to a suction catheter of the type as described in the Dutch patent application 9300626.

A drawback of this suction catheter is that it tends to buckle quite easily under certain circumstances, as a result of which it ceases to function.

The object of the invention is to provide a suction catheter of this type which does not suffer this problem.

This object is achieved with the suction catheter as characterised in claim 1.

It has become apparent that the unfavourable buckling behaviour of the known catheter is due to the asymmetrical cross-section of the basic body.

With the catheter according to the invention the buckling behaviour is only defined by the basic body. The separate tube-like body lies more or less free inside the lumen of the basic body and does not influence the buckling behaviour. Consequently the catheter according to the invention has a constant bending stiffness in all directions which is conducive to the prevention of buckling behaviour.

A further development of the catheter according to the invention is characterised in claim 2. By using separate tube-like bodies for both the pressure channel and the guide wire channel, available cross-sections of the lumen of the basic body are used most effectively, as a result of which even with small diameters of the suction catheter, there is enough cross-section left to function as discharge channel. Also the second separate tube-like body lies substantially free inside the lumen of the basic body, so that this does not influence the bending performance of the catheter.

A suitable, easy to handle embodiment of the catheter according to the invention is characterised in claim 3.

Preferably both measures as set out in claim 4 are employed. As a result, no separate provision for haemostasis is required, so that a manageable unit is obtained.

By employing the measure as set out in claim 5, the trifurcation can form the extreme proximal part of the catheter which means the catheter does not need to comprise any further tube sections for the connection of the different channels.

A suitable, easy to handle embodiment is characterised in claim 7.

Preferably the measure as set out in claim 8 is employed. The integrated spray nozzle forms a liquid jet pump, as a result of which the suction action in the distal end of the catheter will be reinforced. Thus, even when the basic body has a very small diameter, sufficient suction can be created without the need for an additional suction pump.

A favourable further development is characterised in claim 9. As the pressure channel and if necessary the guide wire channel have been formed in separate tube-like bodies, it is not difficult to assemble the basic body from a relatively stiff part and a relatively pliant part during the manufacturing process. Only the basic body parts

need to be connected to each other. The other tube-like members extend continuously. Thus a catheter can be made which is capable of reaching more tortuous blood vessels.

The invention will be explained in greater detail in the following description with reference to the attached drawings.

Fig. 1 shows a partly broken away and cross-sectional view of a catheter according to a first embodiment of the invention.

Fig. 2 shows a trifurcation of a catheter according to the invention in a preferred embodiment.

In fig. 1 the distal end and the proximal end of the catheter 1 have been shown. The intermediate section has been indicated with a dashed and dotted line.

The catheter 1 has a tube-like basic body 2 with a substantially circular cross-section. At the proximal end a trifurcation 15 has been formed, in which several channels, to be described later, are brought together. At the distal end an opening 7 has been formed in the basic body 2. This opening 7 forms a suction inlet which is connected with the lumen 3.

In the lumen 3 a first separate tube-like body 4 has been received. It extends from the proximal end to the distal end. In the tube-like body 4 a channel 5 has been defined which comprises a bent back section 6 in the distal end and ends in a jet nozzle. Liquid under pressure, supplied via channel 5 can thus be directed as a liquid jet 8 along the opening 7, as a result of which a suction will be created indicated by arrow 9.

The trifurcation 15 comprises a first branch 17 which forms an inlet for the pressure channel 5. Inside this branch 17 a tube section 20 has been fixed which is connected to a source of liquid under pressure.

A second branch 18 of the trifurcation 15 forms the connection with the lumen 3 and functions as the discharge channel of the catheter. With the branch 18 a tube section 25 is connected which can be connected to a collecting reservoir.

The third branch 19 is also connected with a tube section 32 and forms a connection with a second separate tube-like body 30 inside the lumen 3. This tube-like body 30 forms a channel for a guide wire 33. The tube-like body 30 has been fed through as far as the distal end of the catheter 1 and has been received with its circumference sealed in the rounded front wall of the distal end. Thus the guide wire 33 can extend over the entire length through the catheter and be pushed out of the front of the catheter at the opening 31. The catheter can thus be passed over the guide wire 33.

As can be seen clearly, a branch 21 of the pressure connection 20 has been received in the trifurcation 15. This branch 21 debouches into the discharge channel 24 with a spray nozzle 22 which is directed in the proximal direction. The liquid under pressure supplied via the pressure line 20 flows partly through the branch 21 and forms a liquid jet indicated with arrow 23 which, as seen in fig. 1, is aimed towards the right. Thus a liquid jet pump is formed in the discharge channel 24 which creates

additional suction in the channel 24. Even in the case of a small diameter of the basic body 2 and hence a relatively small cross-section of the area of the lumen 3 available for the discharge channel, sufficient suction can be created at the opening 7.

As the tubes 4 and 30 are different members which have been received substantially free in the basic body 2, they influence the bending performance of the basic body at the most to a very limited degree. Because of the symmetrical cross-section of the basic body 2 there is no preferred direction as far as bending is concerned so that the basic body is not sensitive to buckling.

Although not shown in the figure, the catheter according to the invention can in a suitable manner be manufactured in such a way that the basic body 2 will be made up of a relatively bending-stiff proximal section and a relatively pliable distal section. Manufacturing such a catheter is relatively simple as the tube-like bodies 30 and 4 do not need to be interrupted. Only one weld needs to be made between the two tube-like sections making up the basic body 2. A catheter manufactured in this way has consequently a more pliable distal end-section as a result of which more tortuous blood vessels can be reached.

The same reference numbers have been used for corresponding parts in fig. 1 and fig. 2.

Just like trifurcation 15, trifurcation 40 has been attached by means of injection moulding to the basic body 2, in which the tube-like bodies 4 and 30 have already been received.

The basic body 2, made up of the tube-like bodies 4 and 30, is placed in a suitably shaped mould and the protruding tube sections 4 and 30 are placed in the desired position. The required spaces, in particular those for forming the channel sections, are kept open by means of core pins which connect to the tube-like bodies and the basic body. A tube section 41 is also received in the mould and thus embedded in the trifurcation 40. This tube section 41 has the same function as the branch 21 in fig. 1.

As fig. 2 shows, the tree-way furcation 40 has been manufactured in such a way that the discharge channel extends in a straight line to a branch 42. The pressure channel 5 and the guide wire channel in the tube-like body 30, are received in the branches 43 and 44 of the trifurcation 40 respectively, which extend laterally, parallel to each other at an oblique angle away from the discharge channel.

The branch 44 in which the tube-like body 30 has been received, is provided with a, as such known, haemostatic valve 45 at its free end. In this way a guide wire can be introduced and removed directly via the branch 44 of the trifurcation, without a need for any additional haemostatic provisions.

The branch 42 of the discharge channel and the branch 43 of the pressure channel are both provided with male Luer-lock adapters 46 and 47 respectively. Consequently the suction catheter according to the invention

provided with the trifurcation 40 has a very compact construction and is easy to handle.

#### Claims

5. 1. Suction catheter comprising a tube-like basic body with a distal and a proximal end, and a pressure channel and a discharge channel formed inside it, wherein at the distal end the pressure channel is connected with a spray nozzle and the discharge channel with a suction inlet and at the proximal end the channels are connected to connecting members, wherein the basic body in cross-section has a substantially constant cross-section with a lumen forming the discharge channel, and the pressure channel has been formed in a separate tube-like body which has been received inside the lumen.
10. 2. Catheter as claimed in claim 1, wherein inside the lumen of the basic body a second separate tube-like body has been received which forms a channel for a guide wire, which second tube-like body at the distal end has been arranged with its circumference sealed in the wall of the basic body and has been provided with an introduction member close to the proximal end.
15. 3. Catheter as claimed in claim 2, comprising a trifurcation at the proximal end with one outlet at the distal side to which the basic body has been connected and three separate outlets at the proximal side for the guide wire channel, the pressure channel and the discharge channel respectively.
20. 35. 4. Catheter as claimed in claim 3, wherein the outlet of the guide wire channel has been provided with a haemostatic valve.
25. 5. Catheter as claimed in claim 3 or 4, wherein the outlets of the pressure channel and the discharge channel are provided with Luer-lock adapters.
30. 6. Catheter as claimed in claim 4 and 5, wherein the haemostatic valve and the Luer-lock adapters have been integrated in the trifurcation.
35. 7. Catheter as claimed in one of the claims 3 - 6, wherein the trifurcation has been manufactured in such a way that the discharge channel extends in a straight line and the guide wire channel and the pressure channel extend laterally, parallel to each other at an oblique angle away from the discharge channel.
40. 55. 8. Catheter as claimed in one of the claims 3 - 7, wherein a connecting channel between the pressure channel and the discharge channel has been formed in the trifurcation which debouches into the dis-

charge channel by means of a spray nozzle directed  
in the proximal direction.

9. Catheter as claimed in one of the previous claims,  
wherein the basic body has been made up of a rel-  
atively stiff proximal section and a relatively pliable  
distal section, and the at least one separate tube-  
like member consists of one continuous unit. 5

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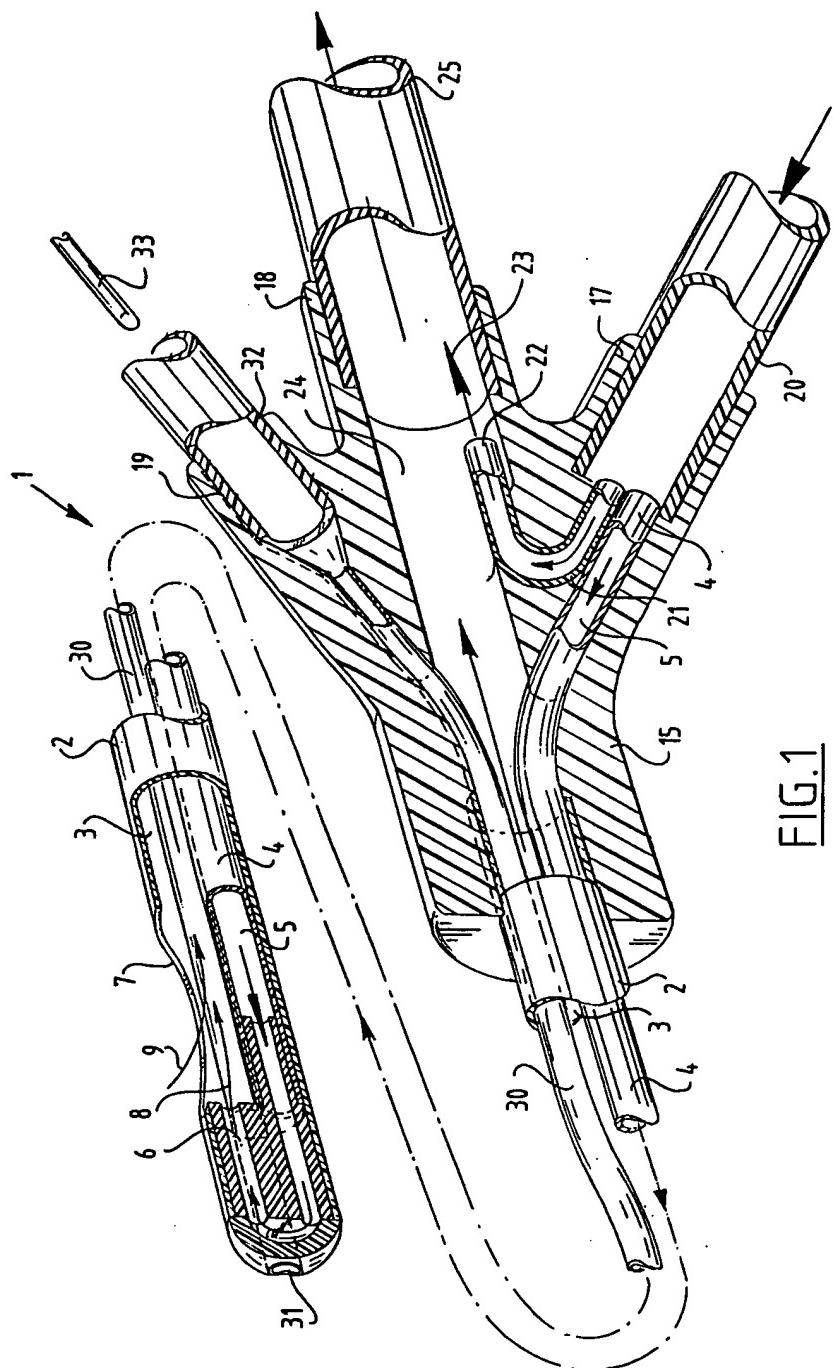


FIG. 1

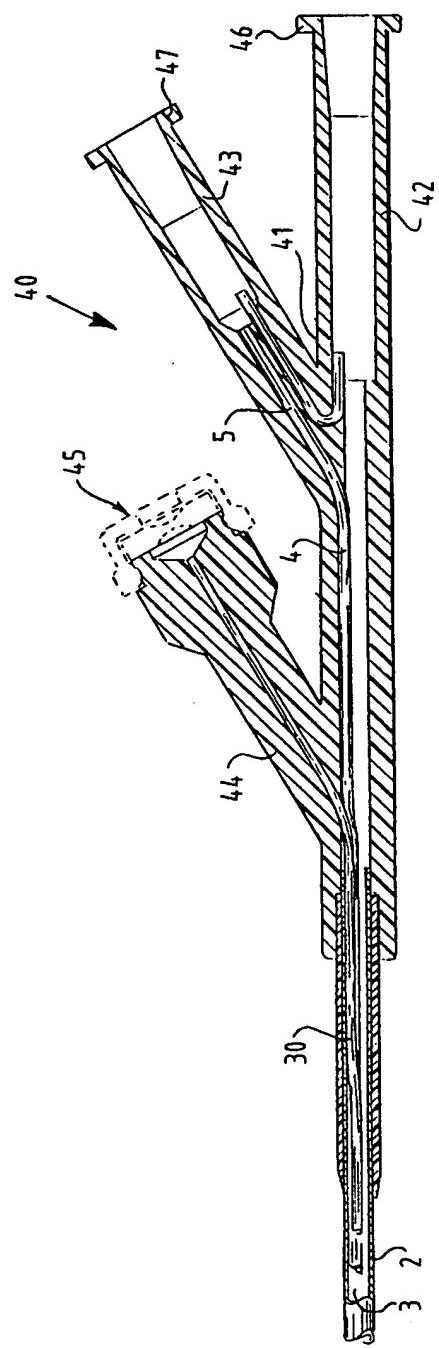


FIG. 2



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## EUROPEAN SEARCH REPORT

Application Number  
EP 95 20 1873

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	EP-A-0 442 579 (CORDIS) 21 August 1991 * the whole document *	1	A61M1/00
Y	---	2	
X	US-A-5 300 022 (KLAPPER) 5 April 1994 * column 3, line 52 - column 4, line 55; figures 2,5,6 *	1	
A	---	3,5	
Y	WO-A-91 05575 (BAXTER) 2 May 1991 * page 13, line 1 - page 14, line 29; figures 1,2 *	2	
A	---	5	
A	US-A-4 637 814 (LEIBOFF) 20 January 1987 * abstract; figure 7 *	3	
A	US-A-5 078 688 (LOBODZINSKI) 7 January 1992 * abstract; figure 1 *	4	
			TECHNICAL FIELDS SEARCHED (Int.Cl.)
			A61M
<p>The present search report has been drawn up for all claims</p>			
Place of search <b>THE HAGUE</b>	Date of compilation of the search <b>4 September 1995</b>	Examiner <b>Kousouretas, I</b>	
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : technological background O : non-written disclosure P : intermediate document B : member of the same patent family, corresponding document	
<small>EPO Road to Success (PCT/GR)</small>			